CALIBRATING GROUP SIZE ESTIMATES OF DOLPHINS IN THE EASTERN TROPICAL PACIFIC OCEAN

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ABSTRACT

Estimates of cetacean abundance from transect surveys rely on unbiased estimates of group size, but estimating the size of a large school of active animals is a difficult task. To evaluate the bias and precision of estimates of dolphin group sizes, we compared estimates made from ships with counts based on aerial photographs taken from a helicopter. The analysis was based on 1,978 estimates of 366 dolphin schools in the eastern tropical Pacific, mostly schools of spotted and spinner dolphins, *Stenella attenuata* and *S. longirostris*. Estimates of group size were highly variable, both among observers for the same school and among schools for the same observer. Treating the data as a calibration problem, we developed correction factors for each of 52 observers, using the counts from the photographs, Beaufort sea state, and year as predictors. The amount and type of bias varied widely among observers, but there was a general tendency to underestimate. Before calibration, mean school size was underestimated by 25.8%; after calibration, the negative bias was reduced to 4.7%. The calibration procedure reduced the mean square error of the logarithms of the estimates from 0.418 to 0.256. Estimating the size of a dolphin school is difficult but critical task in cetacean abundance surveys.

INTRODUCTION

For animals that occur in groups, the estimation of animal abundance depends on accurate assessments of group size. When abundance is estimated by distance sampling, the density of groups is estimated and then multiplied by an estimate of expected group size (Buckland et al., 2001). Alternatively, group size may be a covariate of the detection process and the expected group size is not estimated explicitly (Forcada, 2001). In either case, however, it is assumed that group size is accurately measured.

Line-transect surveys, using either ships or aircraft, have been used to estimate the abundance of cetaceans (Hiby and Hammond, 1989; Miyashita, 1993; Wade and Gerrodette, 1993; Barlow, 1995; Forney et al., 1995; Jaramillo-Legorreta et al., 1999). However, the accurate determination of the number of cetaceans in a group is difficult. Schools of dolphins represent a particularly hard case, because they combine several characteristics that make estimation of size difficult: (1) groups are large (mean size > 100); (2) groups are highly variable in size (range >3 orders of magnitude); (3) the distribution of group sizes is highly skewed, with a long tail of large but rare schools; (4) groups are mobile, with individual animals in constant motion; and (5) at any moment, an unknown number of the individuals in a school is hidden below the surface of the water.

In order to check the accuracy of dolphin school size estimates, the Southwest Fisheries Science Center has utilized aerial photography on its cruises in the eastern tropical Pacific Ocean since 1987. The basic idea has been to photograph entire schools and to compare counts from the photographs to estimates made by observers on the ship. We assessed the estimation tendency of each observer separately, and computed correction factors to improve each observer's estimates of schools that were not photographed. Previous reports summarized data and analyses through 1990 (Gerrodette and Perrin, 1991) and 1996 (Barlow et al., 1998). This report updates the previous reports by including data collected in 1998-2000 and by using slightly different statistical models.

An independent scientific peer review of this work was administered by the Center for Independent Experts located at the University of Miami. Responses to reviewers' comments can be found in Appendix B.

METHODS

Field Methods

Data were collected on nine cruises by the NOAA Ship *David Starr Jordan* in the eastern tropical Pacific Ocean between 1987 and 2000. The primary purpose of these cruises was to collect data, including school size, with which to estimate abundance of dolphins affected by the purse-seine fishery for yellowfin tuna.

A Hughes 500D helicopter carried aboard the ship was used for aerial photography. Under suitable conditions of sea state and sun angle, vertical photographs of dolphin schools were taken from an altitude of 200-300 m with a military reconnaissance camera mounted below the fuselage of the helicopter. The camera recorded images on 114 mm negatives and had a motion-compensation system that moved the film at the same speed the aircraft was moving over the water, thus eliminating blurring due to the forward motion of the helicopter. The cycle rate of the camera was adjusted to achieve 80% overlap between adjacent frames during a photographic pass over a dolphin school. The number of photographic passes of each dolphin school varied with school size, configuration and behavior.

When a school of dolphins was photographed by the helicopter, all marine mammal observers who obtained adequate views of the school (usually all six observers on the ship) made estimates of school size. Each observer made three estimates of school size: best, high and low. Observers made school size estimates independently and did not discuss their estimates with each other, either during the sighting or afterward. Before each cruise, observers were given training on school size estimation, including tests with known numbers of objects and advice on counting by subgroups (e.g., by tens, fifties or hundreds) for more consistent estimation. Training in 1998-2000 included use of a computer program that simulated dolphin schools.

At sea, schools of dolphins were usually detected at distances of 3-5 km using 25X binoculars. After they had been detected, schools were approached to identify the species and to make estimates of school size. The amount of time observers spent with each school varied with the size and behavior of the school, but the ship stayed near the school until all observers felt they had obtained an adequate view.

Analysis

Aerial photographs of dolphin schools were reviewed on light tables equipped with dissection microscopes. Photographs were compared with notes recorded during the photographic passes to ensure that the entire school was captured within the series of images that made up a photograph pass. For schools that were successfully photographed, the best pass was selected, and three individuals independently counted the number of dolphins in the school

(Gilpatrick, 1993). If variability in counts among individuals was unacceptably high (Gilpatrick, 1993) or when notes recorded by aerial and shipboard observers indicated that there was confusion over the identity of the group, the school was not included in the data set.

To evaluate the quality of dolphin school size estimates, we compared observers' estimates with the mean photographic count of the same school. Because differences were clearly related to school size, both estimates and counts were transformed with natural logarithms to standardize variances. Using log-transformed values meant bias was evaluated in a multiplicative sense as the ratio of observer estimate to photo count. Accuracy was evaluated as the mean square error, a combination of bias and variance, also using logarithmically transformed values,

$$\mathrm{MSE} = \frac{1}{n}\sum_{n}(\ln S_{best} - \ln S_{photo})^2 = \frac{1}{n}\sum_{n}\left(\ln\frac{S_{best}}{S_{photo}}\right)^2,$$

where n was the number of estimates, S_{best} was an observer's best estimate of school size and S_{photo} the mean of the three photographic counts for the school. Bias and MSE were computed for all photographed schools and also for each individual observer.

The data are similar to a classical calibration problem, in which there is an accurate method of obtaining a measurement (a photographic count of school size) and another less accurate one (an observer estimate). The problem is that accurate measurements cannot be obtained for every case, while less accurate ones can, and we wish to use the relationship between the two to improve, or "calibrate," the less accurate measurements. The observer estimates Y were estimated as a function of the mean of the photographic counts, with Beaufort sea state and year as additional predictors,

$$\ln Y = \beta_0 + (\beta_1 + \beta_2 * Beaufort + \sum_{j=1}^{9}\beta_j * Year_j)\ln S_{photo}, \tag{1}$$

where *Beaufort* was sea state as measured by the Beaufort scale and $Year_j$ a dummy variable which had a value of 1 if the estimate was made in year j and 0 otherwise. This analysis assumed S_{photo} was without error. In fact, there was variation among the three photographic counts of each school, but the variation among the photo counts was so much less than the variation among observers' estimates that the bias was negligible (Gerrodette and Perrin, 1991). We investigated subsets of this full model, including $\beta_0 = 0$ (regression through the origin), $\beta_1 = 0$ (slope determined only by sea state and year effects), $\beta_2 = 0$ (no sea state effect), and $\beta_j = 0$ (no year effect). We also investigated $Y = S_{best}$ (using the best estimate only) and $Y = w_1 S_{best} + w_2 S_{high} + w_3 S_{low}$ (using a weighted combination of the best, high and low estimates, where $\Sigma w_i = 1$). Coefficients β and weights w were estimated by minimizing the residual sum of squares, using the simplex algorithm of Nelder and Mead (1965). The best model for each observer was selected as the model which minimized the Akaike Information Criterion corrected for sample size, $\mathrm{AIC_c}$ (Hurvich and Tsai, 1989). With the assumption of normally distributed errors, $\mathrm{AIC_c}$ can be computed, except for a constant value, using the estimated regression variance as (Burnham and Anderson, 1998)

$$\mathrm{AIC_c} = n\ln(\hat{\sigma}^2) + 2p + \left(\frac{2p(p+1)}{n-p-1}\right),$$

where n was the number of data points (calibration schools) for the observer, p the number of estimated parameters (number of non-zero β's, plus $\hat{\sigma}^2$), and the regression variance $\hat{\sigma}^2$ was estimated as

$$\hat{\sigma}^2 = \frac{1}{n-p-1}\sum_n (\ln y_i - \ln \hat{y}_i)^2 .$$

We did not analyze observers with $n \le 5$.

Given a set of coefficients β, weights w, and an observer's set of best, high and low estimates for a particular school, a calibrated estimate of school size could be calculated. First, the estimates were combined using the weights as $y = w_1 S_{best} + w_2 S_{high} + w_3 S_{low}$. Under the assumptions of Eq. *1*, ln y had normally distributed errors, which meant y was lognormally distributed. Therefore, $E(\ln y) = \ln E(y) - \hat{\sigma}^2/2$. Solving Eq. *1* for ln S_{photo} gave an estimate of the logarithm of the true school size, and since values of this predictor variable were assumed to measured without error, the calibrated estimate of the size of the i-th school, $S_{cal,i}$ (an estimate of the true size of school i), was

$$S_{cal,i} = \exp\left(\frac{\ln y_i - \hat{\sigma}^2/2 - \beta_0}{\beta_1 + \beta_2 * Beaufort + \sum_{j=1}^{9} \beta_j * Year_j} \right). \qquad (2)$$

Bias and MSE for calibrated estimates were calculated in the same manner as for the original uncalibrated estimates.

RESULTS

Observer estimates tended to be lower than the photographic counts (Fig. 1). The mean of the 1,978 observer best estimates was 173.2, while the mean of the photo counts was 233.5, for a negative bias (underestimation) of 25.8% (Table 1). The mean of high estimates was 221.2, also lower than the mean of the photo counts. The mean of the ratios S_{best}/S_{photo} was 0.875, the median was 0.726, and the distribution was skewed to the right (Table 1, Fig. 2). The distribution of the logarithms of the ratios S_{best}/S_{photo} was approximately normally distributed (Fig. 3), with mean –0.299 and median -0.321 (Table 1).

There were 52 individuals with sufficient data to compute calibration coefficients, with mean sample size $n = 38$, median 32, range 6 to 123 (Table 2). Among these 52 individuals, the ratios of best estimate to photo count varied considerably, with individual mean ratios ranging from 0.46 to 1.34, mean 0.860, median 0.889 and standard deviation 0.233 (Fig. 4, Table 2). A variety of calibration models was selected for the set of 52 observers (Appendix A). Some observers' estimates were not changed by the calibration procedure; some used best, high, or low estimates only, some used a combination of two or all three of these estimates; some observers estimated differently among years, while others did not . Details of the estimated coefficients for all models and all observers, including the AIC_c values used to select the best model for each observer, are given in Appendix A.

When the estimated coefficients were used to calibrate each observer's estimates (Eq. *2*), average statistical properties of the estimates improved. The calibrated estimates were more centered about the 1:1 line (compare Fig. 5 to Fig. 1). The mean of the calibrated estimates was 222.5, compared to the mean photo count of 233.5, for a negative bias of 4.7% (Table 1). The mean of the ratios $S_{calibrated}/S_{photo}$ was 1.029 (slight overestimation), and the median was 0.890 (Table 1). As with the best estimates, the distribution of the ratios $S_{calibrated}/S_{photo}$ was skewed to the right (Fig. 6), while the distribution of the logarithms of the ratios was more symmetrical (Fig. 7). However, the histograms of the calibrated estimates (Figs. 6 and 7) indicated less bias than the histograms of best estimates (Figs. 2 and 3). Mean ratios of $S_{calibrated}/S_{photo}$ among the 52 observers ranged from 0.80 to 1.26, with a mean of 1.033 and median of 1.017 (Table 2). The distribution of these ratios was much closer to 1.0 (compare Fig. 8 with Fig. 4). Variance was still high, but the MSE declined from 0.418 for the uncalibrated estimates to 0.256 for calibrated (Table 1). The reduction of MSE among individuals was similar (Table 2).

DISCUSSION

Among the 52 observers in this study over a 14-year period, there was a general tendency to underestimate school size, both individually and in the aggregate. However, there were also strong differences among individuals; most observers tended to underestimate, but some tended to overestimate. Differences among individuals were also evident in the variety of calibration models selected for the set of 52 observers. When possible, therefore, observer estimates of school size should be adjusted on an individual basis.

Application of the calibration procedure improved the average statistical properties of school size estimates. Mean dolphin school size was underestimated by 25.8% before calibration and by 4.7% after. The MSE decreased from 0.418 to 0.256, a 39% decrease, primarily because of reductions in bias rather than variance.

Estimating the number of dolphins is a difficult visual task. The ability to do this accurately varied considerably by individual. While it was clear that the calibration procedure removed a significant amount of bias in the original school size estimates, it was also clear that considerable variability remained even after the calibration procedure had been applied.

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Table 1. Statistics for dolphin school size calibration for all photographs and estimates.

	Mean	Median
Number of photographed schools	366	
Number of individual estimates	1,978	
School size from photo counts	233.5	94.7
School size from best estimates	173.2	75.0
School size from high estimates	221.2	95.0
School size from low estimates	139.6	60.0
Ratio of best estimate/photo count	0.875	0.726
Log of ratio of best estimate/photo count	-0.299	-0.321
School size from calibrated estimates	222.5	90.3
Ratio of calibrated estimate/photo count	1.029	0.890
Log of ratio of calibrated estimate/photo count	-0.097	-0.117
MSE of best estimates	0.418	
MSE of calibrated estimates	0.256	

Table 2. Statistics for dolphin school size calibration among observers.

	Mean	Median
Number of observers	52	
Number of calibrated schools per observer	38	32
Mean ratio of best estimate/photo count	0.860	0.889
Mean log of ratio of best estimate/photo count	-0.322	-0.251
Mean ratio of calibrated estimate/photo count	1.033	1.017
Mean log of ratio of calibrated estimate/photo count	-0.093	-0.098
MSE of best estimates	0.445	0.392
MSE of calibrated estimates	0.253	0.256

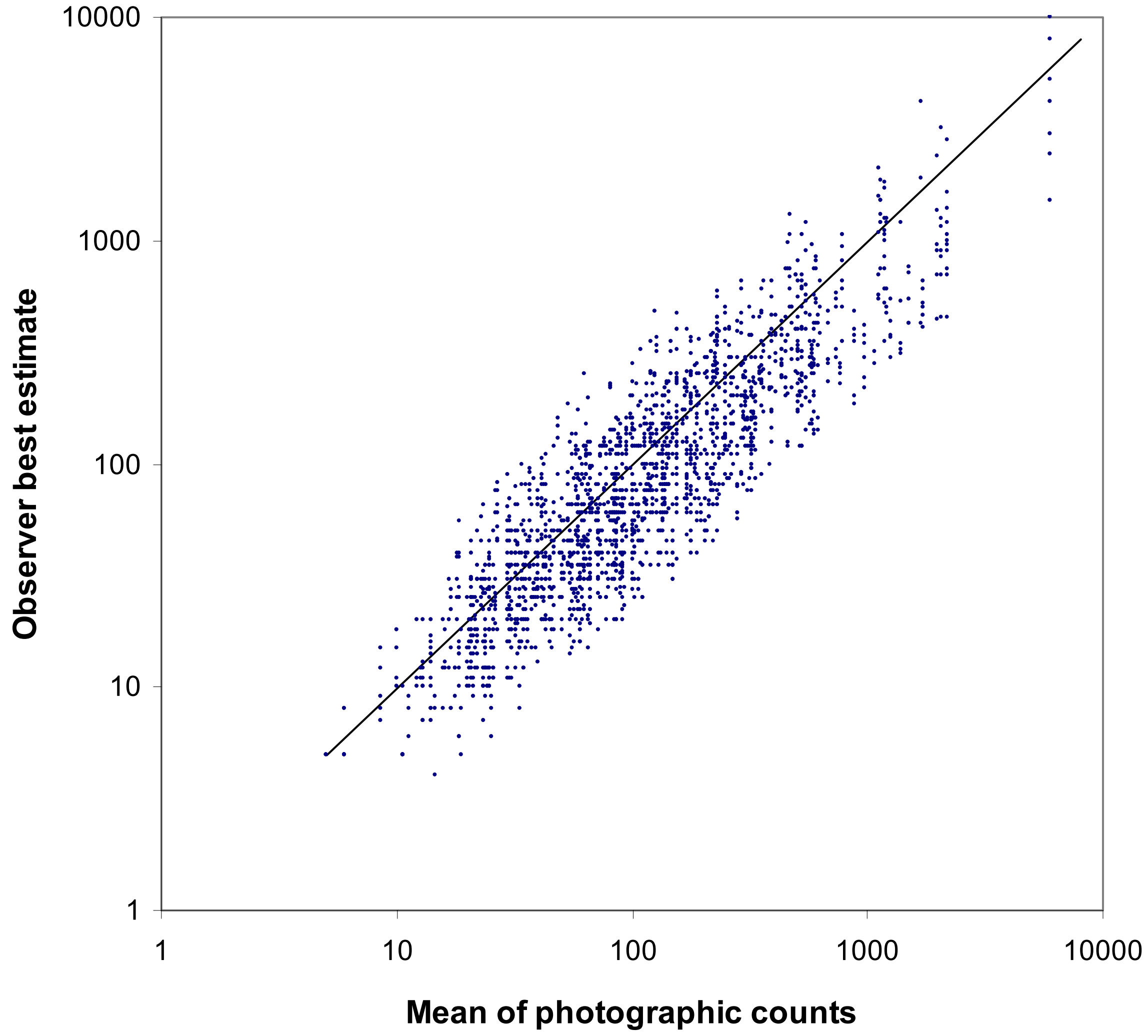

Fig. 1. Observer best estimate plotted against mean photo count. The line is the 1:1 line (estimate=photo count).

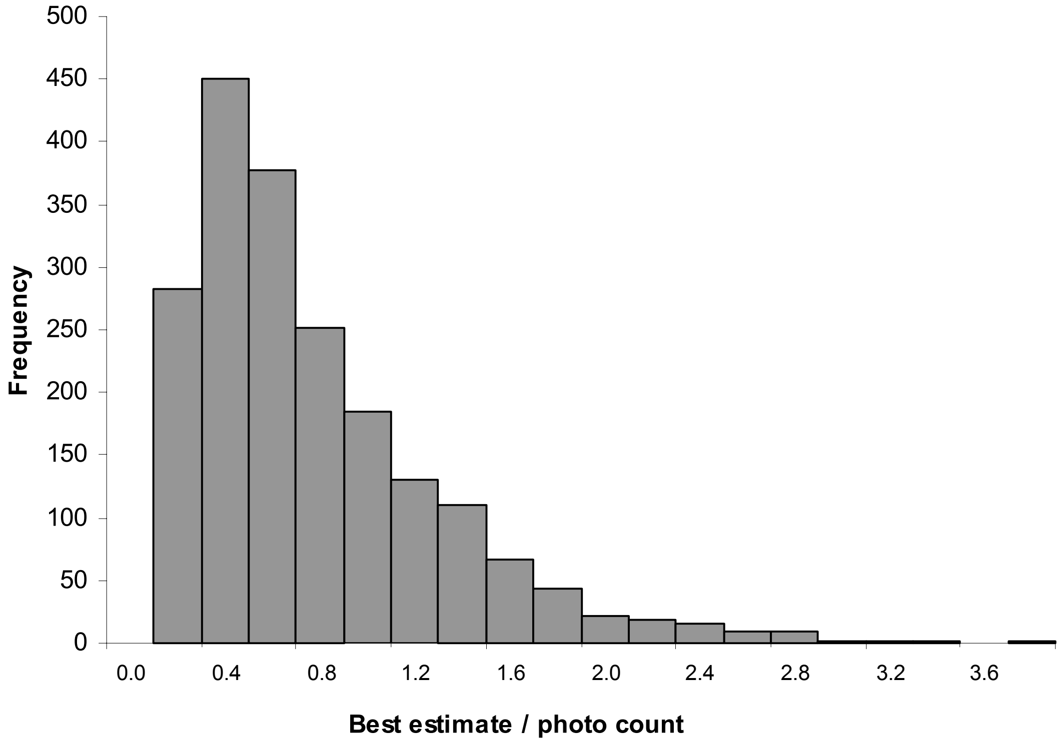

Fig. 2. Distribution of the ratios of observer best estimate to mean photo count.

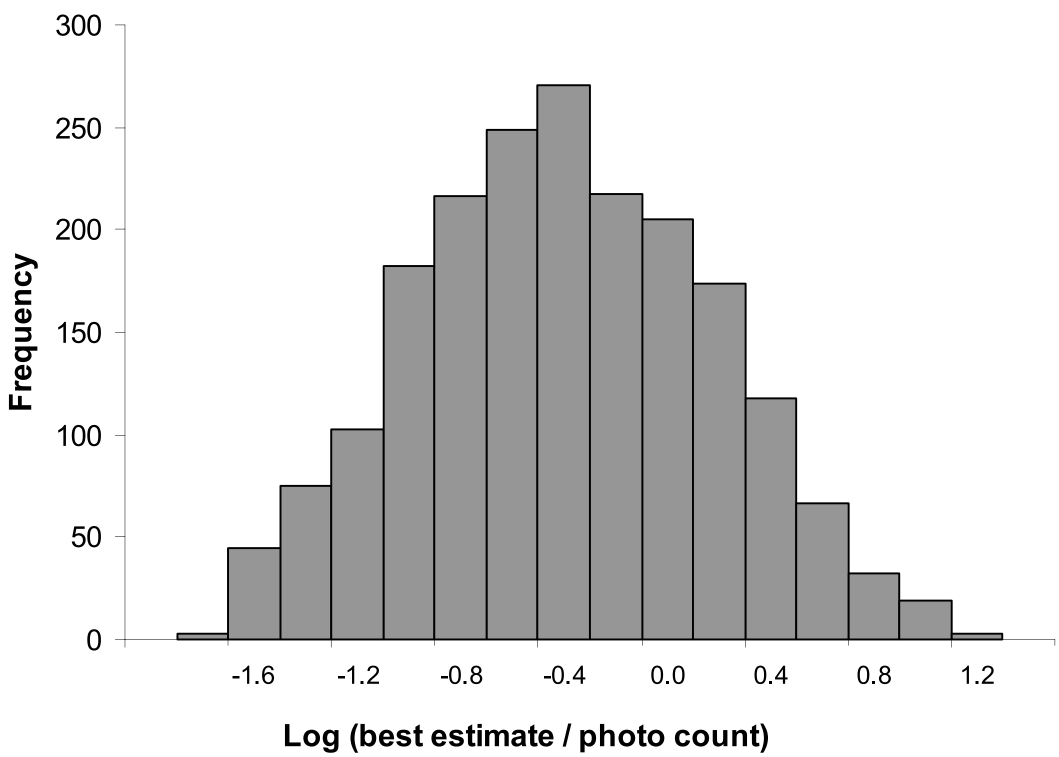

Fig. 3. Distribution of the logarithms of the ratios of observer best estimate to mean photo count.

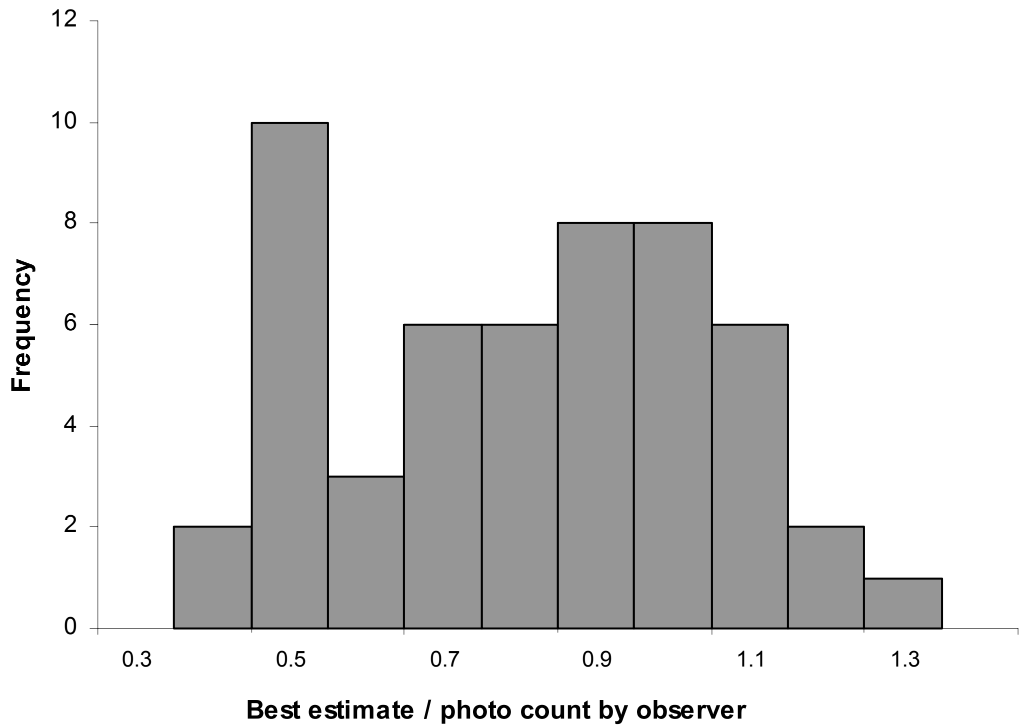

Fig. 4. Distribution of mean ratios of best estimate to photo count among 52 observers.

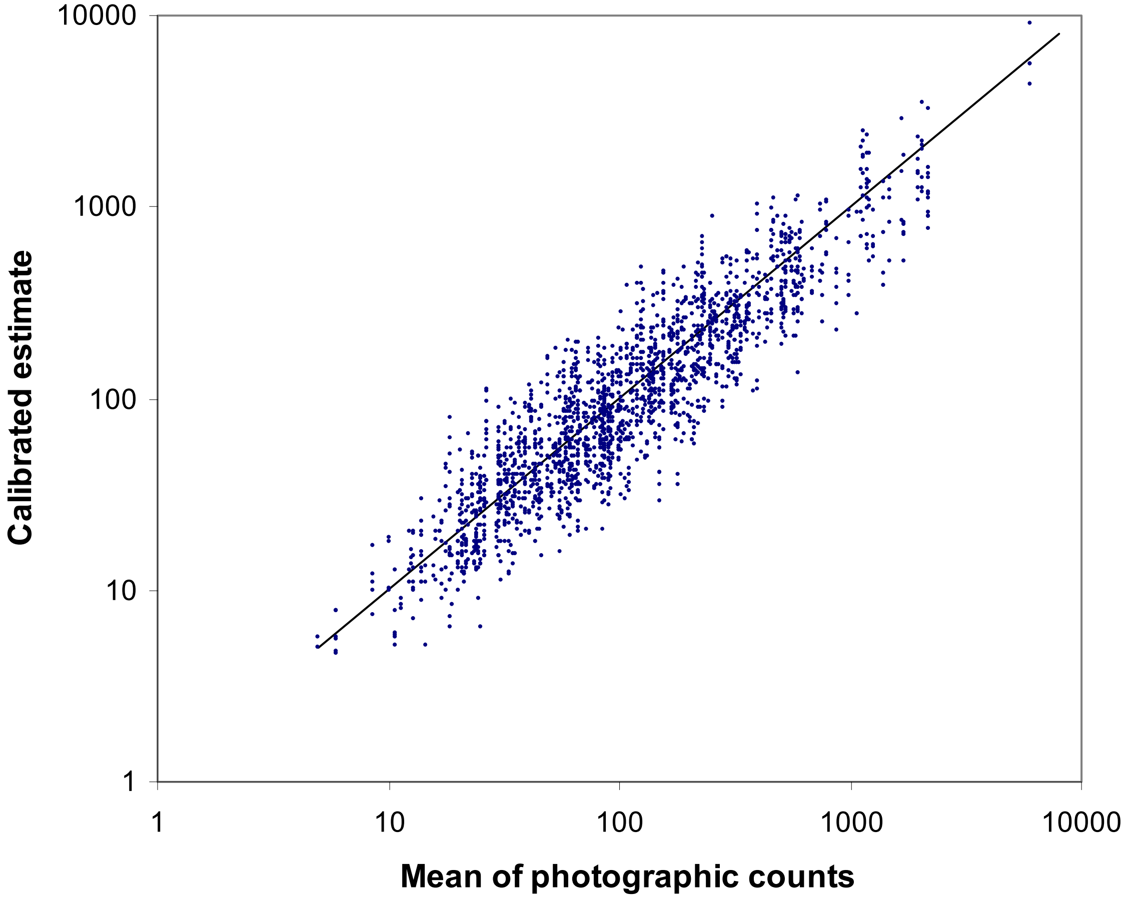

Fig. 5. Calibrated estimate plotted against mean photo count. The line is the 1:1 line (estimate=photo count).

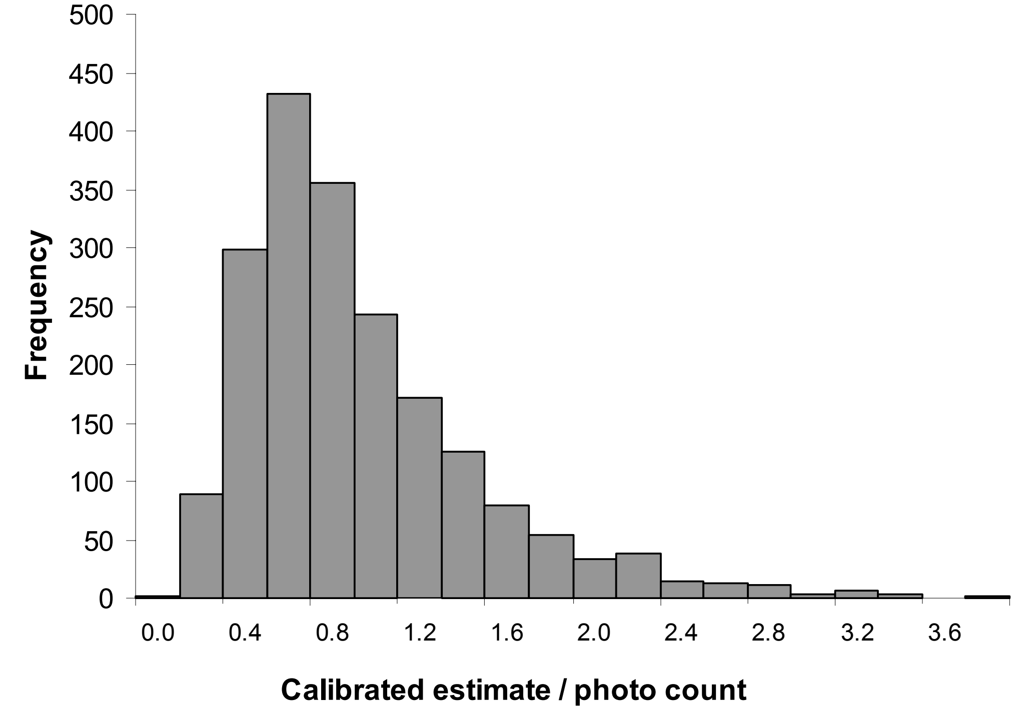

Fig. 6. Distribution of the ratios of calibrated estimate to mean photo count.

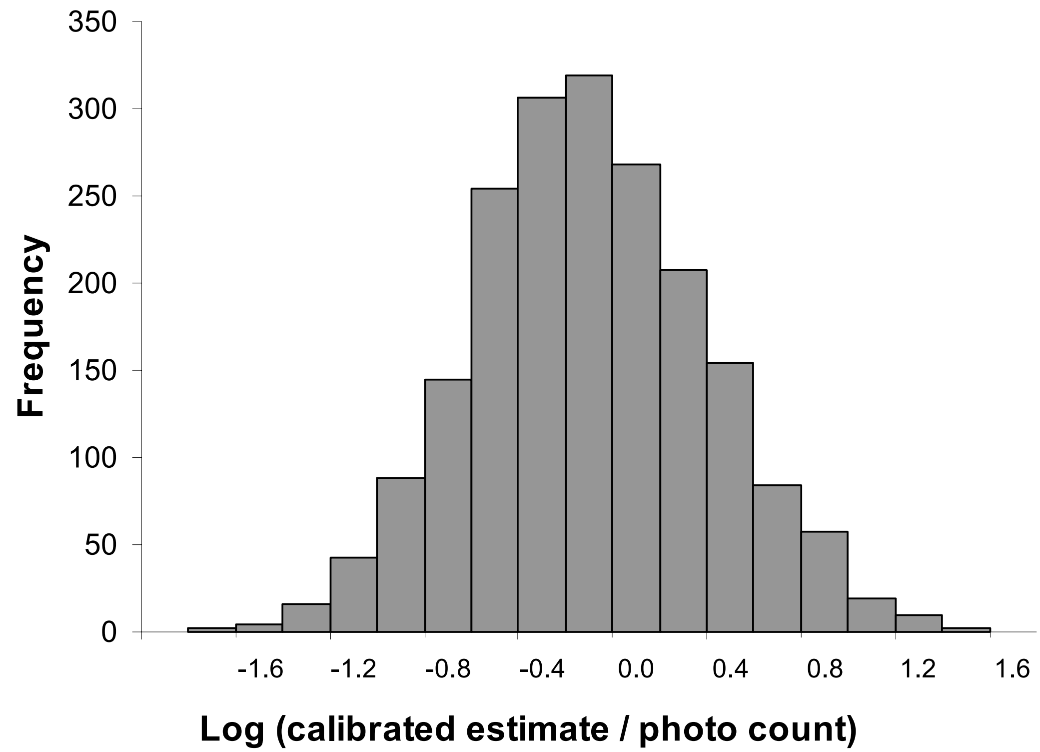

Fig. 7. Distribution of the logarithms of the ratios of calibrated estimate to mean photo count.

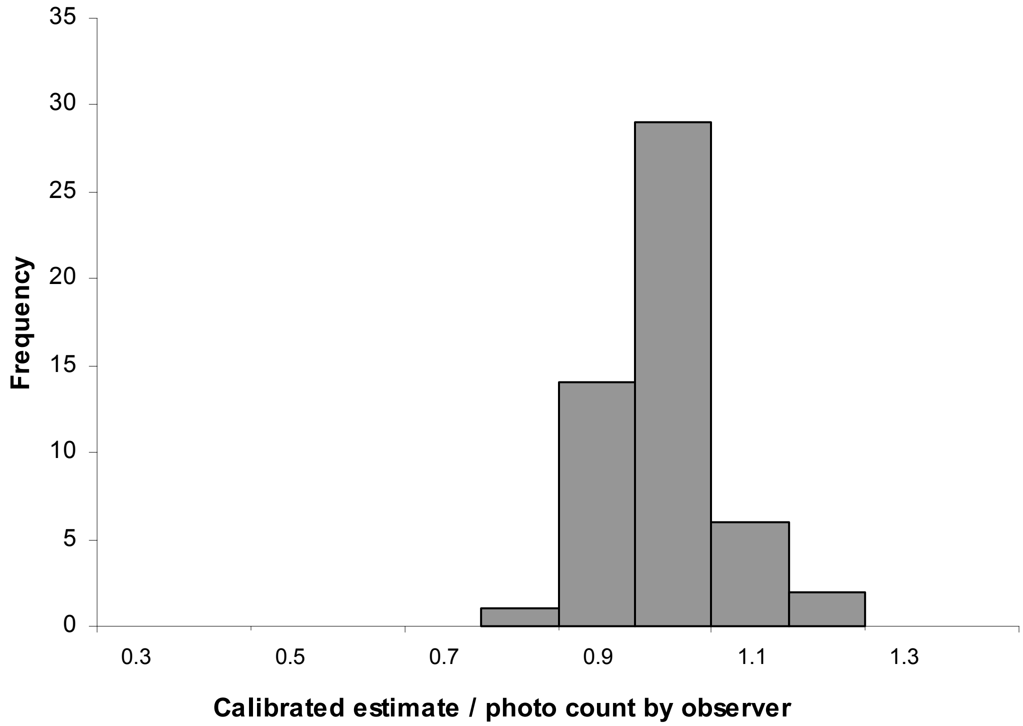

Fig. 8. Distribution of mean ratios of calibrated estimate to photo count among 52 observers. The scale of the x-axis is the same as Fig. 4 for comparison.

Appendix A. Details of modeling results for 52 observers. For each observer, regression coefficients (Eq. 1) were estimated for each of 9 models M and each of 2 weighting schemes: using the observer best estimate only (w_b = 1.0) and using a weighted combination of best, high and low estimates (w_b, w_h and w_l as shown). n is the number of calibration schools for each observer. Observers who have estimates only for one year have only 5 (non-year) models. For each observer, the lowest AIC_c is marked with an asterisk, and the set of regression coefficients associated with this model were used to produce calibrated estimates (Eq. 2) for the observer.

Obs.						Regression coefficients												AIC_c		
No.	n	w_b	w_h	w_l	M	β_0	β_1	β_2	β_{87}	β_{88}	β_{89}	β_{90}	β_{92}	β_{93}	β_{98}	β_{99}	β_{00}	best only	weighted	MSE
1	52	0.00	1.00	0.00	1													-35.0	-55.8	0.3293
					2		0.950											-46.8	-55.8	0.3166
					3	0.302	0.889											-42.7	-47.0	0.3610
					4	0.310	0.908	-0.007										-40.3	-44.7	0.3630
					5		0.968	-0.006										-44.6	-53.7	0.3171
					6			0.001	0.000	0.000	1.022	0.911	0.000	0.941	0.000	0.000	0.000	-49.4	-57.9	0.2658
					7				0.000	0.000	1.025	0.914	0.000	0.944	0.000	0.000	0.000	-52.4	-61.0*	0.2654
					8	0.409			0.000	0.000	0.947	0.830	0.000	0.861	0.000	0.000	0.000	-44.7	-49.5	0.3122
					9	0.408		0.000	0.000	0.000	0.946	0.829	0.000	0.860	0.000	0.000	0.000	-42.8	-47.4	0.3130
2	28	0.62	0.38	0.00	1													-37.1	-43.5*	0.1966
					2		0.969											-41.2	-42.6	0.1895
					3	0.420	0.882											-35.0	-35.8	0.2171
					4	0.420	0.883	0.000										-33.0	-33.7	0.2179
					5		0.991	-0.007										-38.3	-39.6	0.1891
					6			-0.010	1.010	0.000	0.949	0.000	1.192	0.000	0.000	0.000	0.000	-40.0	-41.7	0.1636
					7				0.978	0.000	0.918	0.000	1.152	0.000	0.000	0.000	0.000	-41.8	-43.4	0.1652
					8	0.346			0.907	0.000	0.848	0.000	1.026	0.000	0.000	0.000	0.000	-37.1	-38.0	0.1865
					9	0.325		-0.004	0.925	0.000	0.866	0.000	1.051	0.000	0.000	0.000	0.000	-34.5	-35.3	0.1848
3	56	0.68	0.00	0.32	1													-91.8*	-89.0	0.1970
					2		0.976											-86.8	-85.3	0.2029
					3	-0.103	0.997											-85.5	-86.0	0.1934
					4	-0.120	1.046	-0.015										-85.8	-86.3	0.1857
					5		1.022	-0.015										-86.7	-85.0	0.1969
					6			-0.015	1.019	1.016	1.057	0.000	0.000	0.000	0.000	0.000	0.000	-86.2	-84.8	0.1908
					7				0.970	0.972	1.010	0.000	0.000	0.000	0.000	0.000	0.000	-86.3	-85.0	0.1969
					8	-0.082			0.987	0.988	1.026	0.000	0.000	0.000	0.000	0.000	0.000	-84.5	-85.1	0.1896
					9	-0.101		-0.015	1.041	1.037	1.077	0.000	0.000	0.000	0.000	0.000	0.000	-83.9	-84.5	0.1818

4	116	0.00	0.00	1.00	1													-74.2	-24.8	0.7936
					2		0.840											-131.3	-138.5	0.2928
					3	-0.021	0.844											-116.7	-137.7	0.2897
					4	-0.005	0.876	-0.011										-114.4	-136.2	0.2885
					5		0.876	-0.011										-129.6	-138.0	0.2891
					6			-0.005	0.000	0.000	0.802	0.878	0.884	0.888	0.802	0.872	0.809	-144.4	-145.1	0.2431
					7				0.000	0.000	0.784	0.860	0.869	0.868	0.786	0.857	0.790	-147.0*	-146.6	0.2441
					8	0.086			0.000	0.000	0.766	0.843	0.853	0.852	0.774	0.838	0.771	-127.5	-139.3	0.2554
					9	0.095		-0.006	0.000	0.000	0.784	0.860	0.868	0.872	0.789	0.853	0.790	-124.3	-136.3	0.2556
5	77	0.00	0.37	0.63	1													-74.6	-74.3	0.3714
					2		0.936											-69.2	-76.1	0.3535
					3	-0.883	1.113											-109.8	-119.1	0.1971
					4	-0.871	1.156	-0.015										-109.7	-118.5	0.1934
					5		0.988	-0.017										-69.7	-76.1	0.3444
					6			-0.014	0.935	0.998	0.980	0.993	0.000	0.000	0.000	0.000	0.000	-69.8	-76.2	0.3265
					7				0.891	0.959	0.940	0.947	0.000	0.000	0.000	0.000	0.000	-70.6	-77.3	0.3304
					8	-0.867			1.066	1.127	1.114	1.126	0.000	0.000	0.000	0.000	0.000	-111.8	-121.0*	0.1825
					9	-0.861		-0.013	1.106	1.162	1.150	1.167	0.000	0.000	0.000	0.000	0.000	-110.1	-118.8	0.1806
6	33	0.52	0.48	0.00	1													-52.5	-51.9	0.1952
					2		1.018											-48.8	-50.1	0.1941
					3	-0.179	1.056											-50.9	-51.3	0.1762
					4	-0.356	1.222	-0.033										-53.2	-53.6	0.1498
					5		1.110	-0.024										-48.2	-49.6	0.1853
					6			-0.022	1.117	1.088	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-48.8	-50.4	0.1812
					7				1.035	1.001	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-49.7	-51.1	0.1880
					8	-0.243			1.090	1.051	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-53.1	-53.7	0.1639
					9	-0.408		-0.032	1.247	1.211	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-55.0	-55.6*	0.1412
7	15	0.39	0.61	0.00	1													-34.1*	-33.3	0.0951
					2		1.012											-30.7	-31.0	0.0908
					3	0.335	0.946											-26.9	-26.3	0.1013
					4	0.342	0.934	0.003										-22.9	-22.3	0.1019
					5		1.006	0.002										-27.8	-28.0	0.0910
8	6	0.98	0.02	0.00	1													-13.7*	-13.6	0.0628
					2		1.025											-10.5	-10.5	0.0455
					3	0.128	1.000											-0.2	-0.2	0.0479
					4	0.140	0.998	0.000										29.9	29.9	0.0491
					5		1.025	0.000										-0.5	-0.5	0.0459

9	11	0.00	1.00	0.00	1													-3.1	-15.4	0.2059
					2		0.939											-15.4	-18.1*	0.1222
					3	0.879	0.771											-9.8	-14.4	0.1190
					4	0.901	0.784	-0.009										-4.8	-9.5	0.1183
					5		0.943	-0.002										-11.4	-14.1	0.1223
10	59	0.00	0.00	1.00	1													-59.1	-34.2	0.5417
					2		0.895											-53.1	-55.4	0.3654
					3	-0.511	0.994											-66.4	-70.7	0.2725
					4	-0.513	1.030	-0.012										-66.5	-69.5	0.2689
					5		0.929	-0.012										-53.0	-54.1	0.3611
					6			-0.007	0.873	0.927	0.953	0.000	0.000	0.000	0.000	0.000	0.000	-62.2	-56.8	0.3337
					7				0.852	0.909	0.934	0.000	0.000	0.000	0.000	0.000	0.000	-63.7	-58.6	0.3344
					8	-0.422			0.938	0.991	1.013	0.000	0.000	0.000	0.000	0.000	0.000	-72.9*	-71.0	0.2623
					9	-0.429		-0.007	0.963	1.012	1.035	0.000	0.000	0.000	0.000	0.000	0.000	-70.7	-68.3	0.2607
11	120	0.00	1.00	0.00	1													-127.5	-145.0	0.2936
					2		0.967											-138.0	-142.0	0.2963
					3	0.632	0.839											-114.0	-113.4	0.3699
					4	0.659	0.784	0.014										-113.1	-112.5	0.3664
					5		0.927	0.012										-137.9	-141.8	0.2919
					6			0.006	1.024	0.962	0.945	0.943	0.928	0.915	0.000	0.000	0.000	-140.2	-145.3	0.2629
					7				1.047	0.986	0.966	0.965	0.948	0.934	0.000	0.000	0.000	-142.6	-147.6*	0.2644
					8	0.531			0.928	0.876	0.852	0.863	0.843	0.832	0.000	0.000	0.000	-121.6	-121.0	0.3219
					9	0.558		0.009	0.887	0.834	0.813	0.825	0.806	0.798	0.000	0.000	0.000	-119.3	-118.7	0.3228
12	71	0.00	0.51	0.49	1													-98.0	-95.8	0.2522
					2		1.040											-106.3	-109.1	0.2033
					3	0.913	0.849											-88.6	-92.1	0.2513
					4	0.880	0.909	-0.014										-89.7	-93.2	0.2406
					5		1.114	-0.020										-107.1	-109.9*	0.1954
					6			-0.021	1.089	1.134	1.118	1.123	0.000	0.000	0.000	0.000	0.000	-105.2	-107.7	0.1905
					7				1.011	1.052	1.045	1.049	0.000	0.000	0.000	0.000	0.000	-104.2	-106.8	0.1986
					8	1.018			0.785	0.841	0.830	0.856	0.000	0.000	0.000	0.000	0.000	-85.5	-88.7	0.2490
					9	0.983		-0.014	0.843	0.902	0.885	0.911	0.000	0.000	0.000	0.000	0.000	-85.5	-88.7	0.2388
13	18	0.97	0.03	0.00	1													-6.7	-7.0	0.6081
					2		0.838											-25.8	-25.9*	0.1902
					3	0.410	0.743											-19.3	-19.2	0.2328
					4	0.365	0.793	-0.011										-16.1	-16.1	0.2220
					5		0.891	-0.015										-23.4	-23.5	0.1839

14	33	0.00	0.00	1.00	1													-40.2	-42.0*	0.2633
					2		0.976											-36.6	-37.9	0.2805
					3	0.083	0.959											-32.4	-34.5	0.2933
					4	0.025	1.006	-0.009										-30.1	-32.4	0.2853
					5		1.013	-0.010										-34.6	-35.9	0.2806
					6			-0.009	1.015	1.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-34.6	-36.0	0.2804
					7				0.981	0.972	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-36.7	-38.0	0.2801
					8	0.074			0.965	0.957	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-32.5	-34.7	0.2916
					9	0.020		-0.009	1.008	1.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-30.1	-32.5	0.2845
15	71	0.00	1.00	0.00	1													-100.9	-113.9*	0.1953
					2		0.989											-104.3	-109.9	0.2009
					3	0.456	0.896											-95.8	-97.0	0.2343
					4	0.441	0.922	-0.007										-94.3	-95.9	0.2315
					5		1.023	-0.010										-102.5	-108.6	0.1991
					6			-0.009	1.034	1.017	1.014	1.007	0.000	0.000	0.000	0.000	0.000	-99.0	-105.5	0.1966
					7				1.006	0.983	0.984	0.976	0.000	0.000	0.000	0.000	0.000	-100.8	-107.0	0.1980
					8	0.462			0.913	0.889	0.886	0.887	0.000	0.000	0.000	0.000	0.000	-92.4	-94.1	0.2307
					9	0.449		-0.005	0.933	0.912	0.907	0.909	0.000	0.000	0.000	0.000	0.000	-89.9	-91.8	0.2286
16	51	0.06	0.00	0.94	1													-57.1	-46.2	0.3885
					2		0.929											-54.0	-52.0	0.3334
					3	0.302	0.869											-41.9	-43.1	0.3816
					4	0.349	0.812	0.016										-39.9	-41.1	0.3821
					5		0.889	0.014										-53.0	-50.9	0.3276
					6			0.020	0.826	0.901	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-60.5*	-57.7	0.2866
					7				0.890	0.957	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-60.1	-57.4	0.3001
					8	0.337			0.821	0.890	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-46.7	-47.3	0.3514
					9	0.408		0.022	0.733	0.812	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-46.0	-46.2	0.3458
17	47	0.00	0.00	1.00	1													-61.1	-62.0*	0.2564
					2		0.973											-57.7	-58.4	0.2649
					3	0.307	0.909											-48.1	-50.3	0.3018
					4	0.358	0.843	0.015										-45.3	-47.6	0.3067
					5		0.938	0.009										-55.7	-56.6	0.2640
					6			0.003	0.973	1.000	0.000	0.914	0.000	0.000	0.000	0.000	0.000	-57.9	-59.7	0.2368
					7				0.983	1.011	0.000	0.924	0.000	0.000	0.000	0.000	0.000	-60.0	-61.8	0.2362
					8	0.230			0.932	0.963	0.000	0.880	0.000	0.000	0.000	0.000	0.000	-51.4	-55.1	0.2613
					9	0.254		0.007	0.901	0.931	0.000	0.850	0.000	0.000	0.000	0.000	0.000	-47.6	-51.3	0.2654
18	32	0.16	0.32	0.52	1													-37.9	-38.3*	0.2836
					2		1.012											-36.4	-36.4	0.2830

					3	0.734	0.871											-27.4	-27.1	0.3555
					4	0.735	0.872	0.000										-24.2	-24.0	0.3571
					5		1.009	0.001										-34.3	-34.3	0.2841
					6			0.001	1.001	1.010	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-34.4	-34.3	0.2834
					7				1.005	1.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-36.6	-36.5	0.2823
					8	0.779			0.876	0.859	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-26.9	-26.5	0.3619
					9	0.782		-0.001	0.879	0.862	0.000	0.000	0.000	0.000	0.000	0.000	0.000	-23.8	-23.4	0.3637
19	37	0.00	0.56	0.44	1													-11.0	-17.6	0.5890
					2		0.866											-40.2	-44.8*	0.2675
					3	0.079	0.850											-38.5	-41.2	0.2795
					4	0.105	0.893	-0.014										-35.4	-38.3	0.2783
					5		0.913	-0.013										-38.4	-43.4	0.2631
					6			-0.014	0.000	0.000	0.911	0.918	0.000	0.000	0.000	0.000	0.000	-35.3	-40.4	0.2633
					7				0.000	0.000	0.864	0.870	0.000	0.000	0.000	0.000	0.000	-38.1	-42.7	0.2681
					8	0.101			0.000	0.000	0.842	0.850	0.000	0.000	0.000	0.000	0.000	-35.0	-37.7	0.2834
					9	0.132		-0.014	0.000	0.000	0.885	0.895	0.000	0.000	0.000	0.000	0.000	-32.8	-35.8	0.2824
20	123	0.00	0.31	0.69	1													-140.8	-136.0	0.3256
					2		0.945											-143.6	-144.1	0.3001
					3	0.272	0.891											-125.4	-127.7	0.3371
					4	0.288	0.904	-0.005										-122.7	-124.9	0.3394
					5		0.954	-0.003										-141.5	-142.1	0.3000
					6			0.005	0.000	0.000	0.864	0.954	0.958	0.930	0.934	0.957	0.882	-143.7	-145.6	0.2624
					7				0.000	0.000	0.882	0.971	0.973	0.947	0.951	0.971	0.900	-145.8	-147.3*	0.2630
					8	0.453			0.000	0.000	0.785	0.878	0.894	0.864	0.851	0.872	0.801	-120.5	-123.3	0.3144
					9	0.446		0.002	0.000	0.000	0.779	0.872	0.888	0.858	0.846	0.867	0.794	-119.3	-121.8	0.3132
21	57	0.00	0.33	0.67	1													-81.3	-80.4	0.2355
					2		0.971											-77.5	-77.7	0.2386
					3	0.276	0.916											-68.6	-69.2	0.2673
					4	0.255	1.023	-0.031										-72.2	-73.3	0.2403
					5		1.076	-0.032										-80.8	-81.4*	0.2158
					6			-0.031	0.000	0.000	1.102	1.075	1.079	1.075	0.901	0.000	0.000	-80.5	-80.9	0.1826
					7				0.000	0.000	1.013	0.972	0.972	0.954	0.807	0.000	0.000	-78.3	-78.2	0.2019
					8	0.230			0.000	0.000	0.970	0.924	0.927	0.902	0.774	0.000	0.000	-69.2	-69.6	0.2228
					9	0.152		-0.030	0.000	0.000	1.071	1.040	1.046	1.036	0.876	0.000	0.000	-73.0	-74.0	0.1957
22	34	0.00	0.00	1.00	1													-50.1*	-46.2	0.2423
					2		0.952											-46.3	-46.0	0.2296
					3	-0.057	0.964											-42.6	-44.9	0.2235
					4	-0.047	1.049	-0.025										-41.1	-43.1	0.2159

					5		1.039	-0.025										-45.9	-45.4	0.2207
					6			-0.018	0.000	0.000	0.000	1.024	0.000	0.980	0.000	0.000	0.000	-44.6	-43.9	0.2112
					7				0.000	0.000	0.000	0.967	0.000	0.913	0.000	0.000	0.000	-47.1	-46.5	0.2136
					8	0.052			0.000	0.000	0.000	0.956	0.000	0.900	0.000	0.000	0.000	-40.6	-42.5	0.2200
					9	0.039		-0.017	0.000	0.000	0.000	1.016	0.000	0.970	0.000	0.000	0.000	-38.3	-40.1	0.2163
23	11	0.37	0.00	0.63	1													2.1	2.7	1.0623
					2		0.807											-14.8	-16.9	0.1363
					3	1.260	0.567											-25.7	-27.8*	0.0352
					4	1.257	0.546	0.006										-21.8	-23.5	0.0330
					5		0.780	0.008										-11.0	-13.1	0.1344
24	17	0.47	0.29	0.25	1													-16.8	-18.2	0.3042
					2		0.951											-18.0	-19.3	0.2544
					3	0.717	0.829											-12.4	-13.7	0.2953
					4	0.608	0.700	0.052										-13.1	-14.5	0.2236
					5		0.785	0.058										-19.2	-20.4	0.2000
					6			0.088	0.000	0.000	0.000	0.000	0.713	0.552	0.000	0.000	0.000	-19.5	-20.4*	0.1580
					7				0.000	0.000	0.000	0.000	0.955	0.903	0.000	0.000	0.000	-15.6	-16.7	0.2476
					8	0.705			0.000	0.000	0.000	0.000	0.834	0.788	0.000	0.000	0.000	-8.9	-10.2	0.2872
					9	0.516		0.080	0.000	0.000	0.000	0.000	0.647	0.500	0.000	0.000	0.000	-14.2	-15.2	0.1694
25	24	0.39	0.00	0.61	1													-22.9	-10.3	0.5981
					2		0.880											-34.9	-36.9*	0.1820
					3	0.615	0.774											-29.9	-31.1	0.2048
					4	0.623	0.778	-0.002										-26.8	-27.9	0.2059
					5		0.868	0.004										-32.1	-33.8	0.1824
26	76	0.00	0.22	0.78	1													-43.7	-32.4	0.6358
					2		0.865											-88.4	-90.8	0.2871
					3	-0.174	0.899											-89.6	-96.0*	0.2612
					4	-0.201	0.928	-0.007										-92.2	-95.5	0.2561
					5		0.882	-0.005										-88.5	-89.2	0.2859
					6			-0.001	0.000	0.000	0.000	0.000	0.845	0.842	0.874	0.867	0.898	-87.8	-83.9	0.2721
					7				0.000	0.000	0.000	0.000	0.843	0.839	0.872	0.865	0.896	-89.6	-86.1	0.2716
					8	-0.125			0.000	0.000	0.000	0.000	0.869	0.865	0.897	0.890	0.920	-87.3	-89.1	0.2541
					9	-0.136		-0.002	0.000	0.000	0.000	0.000	0.878	0.876	0.909	0.900	0.928	-85.8	-86.5	0.2528
27	76	0.00	0.05	0.95	1													-62.8	-44.9	0.5392
					2		0.891											-67.5	-79.5	0.3334
					3	0.685	0.753											-37.0	-56.6	0.4389
					4	0.695	0.741	0.003										-34.3	-54.0	0.4422

					5		0.895	-0.001										-65.4	-77.4	0.3338
					6			-0.012	0.000	0.000	0.000	0.000	0.862	0.941	0.989	0.923	0.930	-76.1	-80.8	0.2833
					7				0.000	0.000	0.000	0.000	0.823	0.893	0.941	0.885	0.893	-76.1	-81.3*	0.2892
					8	0.694			0.000	0.000	0.000	0.000	0.681	0.757	0.796	0.741	0.764	-47.2	-58.3	0.3811
					9	0.667		-0.007	0.000	0.000	0.000	0.000	0.707	0.788	0.827	0.766	0.788	-46.0	-57.1	0.3725
28	27	0.43	0.57	0.00	1													-24.1	-29.0	0.3178
					2		0.954											-25.5	-27.5	0.3116
					3	-0.477	1.039											-31.1	-31.8*	0.2373
					4	-0.391	1.077	-0.018										-29.1	-29.8	0.2373
					5		1.027	-0.024										-24.4	-26.2	0.2921
29	53	1.00	0.00	0.00	1													-12.4	-12.4	0.7617
					2		0.858											-65.1	-65.1	0.2713
					3	0.255	0.812											-57.5	-57.5	0.3016
					4	0.225	0.779	0.013										-59.2	-59.2	0.2814
					5		0.817	0.014										-66.3*	-66.3	0.2557
					6			0.013	0.000	0.000	0.000	0.000	0.812	0.824	0.000	0.000	0.000	-64.5	-64.5	0.2547
					7				0.000	0.000	0.000	0.000	0.851	0.865	0.000	0.000	0.000	-63.7	-63.7	0.2685
					8	0.233			0.000	0.000	0.000	0.000	0.811	0.821	0.000	0.000	0.000	-56.4	-56.4	0.2969
					9	0.209		0.013	0.000	0.000	0.000	0.000	0.778	0.786	0.000	0.000	0.000	-56.7	-56.7	0.2789
30	46	0.70	0.30	0.00	1													-52.5	-58.3*	0.2694
					2		1.000											-48.7	-53.8	0.2848
					3	0.202	0.960											-47.2	-47.8	0.3103
					4	0.262	0.896	0.017										-45.3	-46.3	0.3074
					5		0.952	0.015										-48.0	-53.2	0.2758
					6			0.015	0.000	0.000	0.000	0.000	0.919	0.968	0.000	0.000	0.000	-48.0	-53.4	0.2633
					7				0.000	0.000	0.000	0.000	0.968	1.016	0.000	0.000	0.000	-48.5	-53.8	0.2727
					8	0.232			0.000	0.000	0.000	0.000	0.921	0.971	0.000	0.000	0.000	-46.3	-47.2	0.3015
					9	0.294		0.017	0.000	0.000	0.000	0.000	0.854	0.905	0.000	0.000	0.000	-43.6	-44.8	0.2974
31	55	0.00	0.38	0.62	1													-12.8	-14.9	0.7359
					2		0.846											-76.7	-81.8*	0.2102
					3	-0.005	0.847											-77.5	-79.8	0.2100
					4	-0.006	0.824	0.008										-76.8	-78.8	0.2062
					5		0.822	0.007										-76.0	-80.7	0.2067
					6			0.007	0.000	0.000	0.000	0.000	0.811	0.836	0.000	0.000	0.000	-75.3	-79.9	0.2024
					7				0.000	0.000	0.000	0.000	0.832	0.858	0.000	0.000	0.000	-76.4	-81.2	0.2049
					8	-0.029			0.000	0.000	0.000	0.000	0.837	0.864	0.000	0.000	0.000	-78.1	-80.0	0.2020
					9	-0.029		0.007	0.000	0.000	0.000	0.000	0.817	0.842	0.000	0.000	0.000	-76.0	-77.7	0.1994

32	33	0.00	0.30	0.70	1													-16.0	-19.6	0.5196
					2		0.918											-17.3	-21.4*	0.4630
					3	0.093	0.900											-15.9	-17.8	0.4864
					4	0.251	0.806	0.017										-11.0	-12.6	0.5192
					5		0.876	0.011										-15.5	-19.6	0.4601
					6			0.007	0.000	0.000	0.000	0.000	0.872	0.911	0.000	0.000	0.000	-14.4	-17.4	0.4497
					7				0.000	0.000	0.000	0.000	0.895	0.937	0.000	0.000	0.000	-17.5	-20.3	0.4502
					8	0.084			0.000	0.000	0.000	0.000	0.878	0.920	0.000	0.000	0.000	-15.3	-15.8	0.4717
					9	0.189		0.011	0.000	0.000	0.000	0.000	0.819	0.856	0.000	0.000	0.000	-11.5	-11.3	0.4938
33	28	0.00	1.00	0.00	1													-8.0	-16.3	0.5195
					2		0.888											-24.7	-28.8*	0.3104
					3	0.259	0.836											-19.6	-22.3	0.3511
					4	0.236	0.864	-0.007										-18.7	-21.0	0.3431
					5		0.915	-0.009										-22.3	-26.2	0.3054
34	18	1.00	0.00	0.00	1													-16.2*	-16.2	0.3644
					2		1.008											-12.3	-12.3	0.4045
					3	-0.563	1.128											-14.5	-14.5	0.3027
					4	-0.627	1.300	-0.043										-11.7	-11.7	0.2834
					5		1.143	-0.037										-9.8	-9.8	0.3940
35	7	0.00	1.00	0.00	1													-2.2	-9.2*	0.2021
					2		0.944											-4.5	-7.3	0.1300
					3	0.436	0.864											2.1	0.8	0.1524
					4	1.409	0.436	0.064										16.8	15.8	0.1743
					5		0.838	0.027										0.2	-0.9	0.1191
36	8	0.00	0.00	1.00	1													-4.2*	-3.4	0.5082
					2		0.914											0.0	-1.2	0.4046
					3	1.290	0.656											8.8	7.2	0.5485
					4	1.190	0.598	0.027										15.1	14.2	0.4265
					5		0.821	0.032										4.1	3.3	0.3354
37	37	1.00	0.00	0.00	1													-31.6*	-31.6	0.4030
					2		0.959											-27.3	-27.3	0.4293
					3	0.717	0.801											-13.1	-13.1	0.5967
					4	0.733	0.762	0.011										-10.2	-10.2	0.5951
					5		0.930	0.009										-25.5	-25.5	0.4265
					6			0.012	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.928	0.914	-22.4	-22.4	0.4285
					7				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.961	0.956	-25.1	-25.1	0.4315
					8	0.717			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.802	0.798	-9.9	-9.9	0.6003

					9	0.735		0.014	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.759	0.745	-8.0	-8.0	0.5986
38	32	0.00	1.00	0.00	1													-36.3	-40.9*	0.2614
					2		0.998											-33.5	-37.5	0.2730
					3	0.483	0.902											-31.0	-29.9	0.3256
					4	0.417	0.965	-0.016										-30.6	-28.8	0.3073
					5		1.058	-0.019										-32.9	-36.8	0.2627
					6			-0.017	0.000	0.000	0.000	0.000	0.000	0.000	1.037	1.002	1.080	-32.8	-35.2	0.2288
					7				0.000	0.000	0.000	0.000	0.000	0.000	0.981	0.949	1.030	-34.3	-36.8	0.2387
					8	0.682			0.000	0.000	0.000	0.000	0.000	0.000	0.832	0.808	0.903	-27.9	-27.2	0.2939
					9	0.627		-0.011	0.000	0.000	0.000	0.000	0.000	0.000	0.880	0.853	0.945	-27.4	-25.8	0.2791
39	47	0.00	0.01	0.99	1													-25.6	-4.5	0.8700
					2		0.831											-36.2	-36.9*	0.4188
					3	0.059	0.818											-26.9	-33.3	0.4338
					4	0.065	0.832	-0.005										-24.7	-31.2	0.4346
					5		0.846	-0.005										-34.1	-35.0	0.4182
					6			0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.787	0.843	0.800	-30.5	-31.6	0.4040
					7				0.000	0.000	0.000	0.000	0.000	0.000	0.808	0.858	0.813	-33.4	-34.7	0.4027
					8	-0.007			0.000	0.000	0.000	0.000	0.000	0.000	0.809	0.859	0.814	-23.9	-31.8	0.4025
					9	-0.009		0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.789	0.845	0.802	-21.0	-28.7	0.4034
40	21	1.00	0.00	0.00	1													-28.8	-28.8	0.2301
					2		0.972											-27.0	-27.0	0.2284
					3	1.315	0.696											-15.5	-15.5	0.3427
					4	1.058	0.563	0.049										-21.8	-21.8	0.2201
					5		0.740	0.060										-30.7*	-30.7	0.1660
41	9	0.00	0.47	0.53	1													-9.9*	-9.8	0.2697
					2		0.961											-6.9	-6.8	0.2407
					3	1.667	0.621											-8.2	-9.5	0.1150
					4	1.641	0.606	0.007										-1.0	-2.2	0.1063
					5		0.918	0.015										-3.4	-3.3	0.2281
42	29	0.74	0.26	0.00	1													-1.1	-4.1	0.8094
					2		0.821											-44.9	-45.5*	0.1811
					3	0.315	0.755											-39.7	-39.1	0.2109
					4	0.410	0.679	0.015										-35.9	-35.2	0.2179
					5		0.783	0.010										-43.5	-43.9	0.1789
					6			0.009	0.000	0.000	0.000	0.000	0.000	0.000	0.789	0.784	0.000	-40.4	-40.8	0.1793
					7				0.000	0.000	0.000	0.000	0.000	0.000	0.826	0.812	0.000	-43.0	-43.6	0.1807
					8	0.295			0.000	0.000	0.000	0.000	0.000	0.000	0.762	0.752	0.000	-37.0	-36.4	0.2089

					9	0.445		0.018	0.000	0.000	0.000	0.000	0.000	0.000	0.659	0.668	0.000	-32.2	-31.6	0.2223
43	20	0.00	1.00	0.00	1													-15.6	-23.8*	0.2759
					2		0.970											-19.6	-21.5	0.2800
					3	1.394	0.681											-8.1	-8.4	0.4641
					4	1.132	0.569	0.043										-10.4	-11.6	0.3395
					5		0.759	0.055										-20.1	-22.9	0.2241
44	9	0.00	0.00	1.00	1													-8.3*	-5.5	0.4324
					2		0.916											-3.4	-3.0	0.3670
					3	-0.467	1.011											-0.2	-1.4	0.2806
					4	-0.519	0.980	0.014										7.0	6.2	0.2693
					5		0.882	0.012										0.1	0.9	0.3626
45	9	0.00	0.00	1.00	1													-0.3	2.3	1.0374
					2		0.816											-2.0*	-1.8	0.4206
					3	-0.450	0.907											2.2	-0.2	0.3235
					4	-1.093	1.185	-0.049										5.8	3.2	0.1933
					5		0.887	-0.023										0.9	1.8	0.4012
46	9	0.00	0.00	1.00	1													-1.2	1.0	0.8985
					2		0.813											-9.3	-9.8*	0.1733
					3	0.152	0.782											-4.1	-5.0	0.1886
					4	0.150	0.780	0.001										3.7	3.1	0.1911
					5		0.809	0.001										-5.4	-5.7	0.1744
47	19	1.00	0.00	0.00	1													-0.4	-0.4	0.8807
					2		0.824											-17.7	-17.7	0.3199
					3	0.342	0.752											-11.3	-11.3	0.3814
					4	0.312	0.803	-0.013										-9.2	-9.2	0.3648
					5		0.871	-0.014										-15.3	-15.3	0.3089
					6			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.922	0.000	0.789	-19.1	-19.1	0.2162
					7				0.000	0.000	0.000	0.000	0.000	0.000	0.923	0.000	0.790	-22.2*	-22.2	0.2154
					8	0.663			0.000	0.000	0.000	0.000	0.000	0.000	0.797	0.000	0.647	-14.2	-14.2	0.2804
					9	0.686		0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.781	0.000	0.625	-9.6	-9.6	0.2881
48	37	0.04	0.96	0.00	1													-31.4	-38.6*	0.3334
					2		0.975											-35.8	-35.6	0.3430
					3	1.635	0.614											-15.5	-13.3	0.5939
					4	1.592	0.721	-0.031										-16.8	-15.1	0.5220
					5		1.085	-0.035										-37.1	-36.9	0.3139
					6			-0.031	0.000	0.000	0.000	0.000	0.000	0.000	0.000	1.082	1.052	-34.9	-34.1	0.3123

					7				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.995	0.941	-35.6	-34.5	0.3346
					8	1.631			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.634	0.582	-14.2	-11.3	0.5778
					9	1.595		-0.026	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.716	0.685	-15.2	-13.1	0.5210
49	23	0.09	0.00	0.91	1													-5.0	2.0	1.0020
					2		0.818											-26.9	-25.0	0.2834
					3	-0.557	0.927											-31.0*	-30.9	0.1924
					4	-0.603	0.963	-0.009										-28.7	-28.7	0.1859
					5		0.828	-0.003										-23.8	-21.9	0.2844
					6			-0.003	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.800	0.843	-21.2	-19.6	0.2761
					7				0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.792	0.835	-24.3	-22.7	0.2747
					8	-0.483			0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.892	0.924	-27.6	-27.6	0.1952
					9	-0.527		-0.008	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.926	0.957	-25.2	-25.3	0.1895
50	22	0.14	0.13	0.73	1													-15.9	-9.0	0.6057
					2		0.859											-23.6*	-22.7	0.2970
					3	0.692	0.707											-13.0	-12.6	0.4108
					4	0.680	0.677	0.011										-10.0	-9.7	0.4079
					5		0.822	0.013										-20.5	-19.8	0.2957
51	14	1.00	0.00	0.00	1													-10.1*	-10.1	0.4208
					2		0.949											-6.3	-6.3	0.4456
					3	0.454	0.849											-0.1	-0.1	0.5613
					4	0.496	0.802	0.010										4.3	4.3	0.5761
					5		0.923	0.007										-3.2	-3.2	0.4491
52	15	0.00	1.00	0.00	1													-3.6	-8.6*	0.4924
					2		0.954											-3.3	-5.8	0.4863
					3	2.346	0.518											9.5	5.0	0.8199
					4	2.325	0.544	-0.007										12.2	8.7	0.8047
					5		1.000	-0.016										-1.0	-2.9	0.4821

Appendix B. Responses to comments by reviewers from the Center for Independent Experts. References to page numbers refer to the documents produced by each reviewer.

Responses to comments by Dr. Robert Mohn

p. 3: In the estimation of spotted and spinner dolphin abundance, results of this paper have been applied to the estimates of observers who were not "calibrated."

p. 5: Without doubt there is a great deal of variability assoicated with estimating dolphin school size from a boat, even for very experienced observers. The ideal would be to provide feedback to observers in real time about the accuracy of their estimates, but this is not possible because the photographs have to be developed and then counted. Digital video imagery from a helicopter might make near-real-time feedback possible, but at present the resolution of this technology is far below what would be required to obtain reliable dolphin school size counts.

Responses to comments by Dr. Paul Medley

p. 4: The GLM equation proposed models true school size (photo count) as a function of the estimates plus error. Logically, however, the errors lie in the estimates, not in the photo counts, so the estimates should be the predicted quantity. Thus, the estimates are modelled as a function of true school size plus estimation error. This is also why calibration requires "reversal" of the equation. The fit does minimize the difference between the corrected estimate and the photo count, not the opposite as the reviewer suggests. Application of the calibration results to all observers has been addressed in the estimation of spotted and spinner dolphin abundance, and the uncertainty due to the calibration procedure has also been carried forward in the bootstrap procedure for the population estimates. We agree that a single model fit simultaneously to all observers is theoretically preferable to the individually fitted models, but that such a model may be prohibitively large. It is a subject for future investigation.